Understanding inappropriateness in health spending: The role of regional policies and institutions in caesarean deliveries

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Understanding Inappropriateness in Health Spending: The Role of Regional Policies and Institutions in Caesarean Deliveries[♠]

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Abstract

We analyze the determinants of caesarean sections and the role regional policies and institutions can play in controlling for inappropriateness in healthcare. We consider Italy as a case study, given that in the country: caesarean sections are above OECD average at the national level but regional variations are significant; almost all childbirths are managed within the National Health Service, in a public or a private hospital; regional governments are in charge of managing and funding (at least partially) health care services. Controlling for average patientsô characteristics and the riskiness of births, in the attempt to separate ñappropriateò from ñinappropriateò treatments, we find that regional policies and institutions do matter. In particular, our results suggest that decentralized DRG tariffs might be an effective policy tool to control inappropriateness, once the role of private hospitals is taken into account. Also the degree of fiscal autonomy in funding regional health expenditure, and the experience of regional governmentôs president are important.

Keywords: health care, inappropriateness, regional disparities, supply structure, pricing policy, political institutions

JEL Classification: H75, I18, L33, R50

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1. Introduction

The expected growth in public health expenditure is a relevant policy issue in almost all developed countries. Not surprisingly, improving spending efficiency while guaranteeing (or even enhancing) citizensô health is becoming a key challenge for policy-makers. A common suggestion coming from the policy-oriented literature is to foster service appropriateness: delivering appropriate services would produce cost savings, while contemporaneously ensuring at least the same level of citizensô health (e.g., OECD, 2004). The incidence of caesarean sections on total childbirths is an indicator of inappropriateness commonly considered in the literature, and by policy-makers (see, e.g., OECD, 2009; for Italy, the indicators regularly published by the Italian Health Ministry in its annual report on hospital production, and Fortino *et al.,* 2002). Being a surgical treatment, a caesarean section is characterised by a large cost (and risk) differential with respect to the alternative classical vaginal delivery (a medical treatment). Absent any clinically necessary reasons which justify the use of a caesarean section, vaginal delivery is generally considered an appropriate (and less risky) way of childbirth, which can clearly help in containing health care costs[1].

However, despite these considerations, an upward trend in the incidence of caesarean deliveries is a well documented stylised fact at the international level, which is intrinsically connected with the rise of medical intervention in childbirth in many nations (e.g., Johanson et al., 2002). The main explanations for this increasing tendency proposed by the literature focus mostly on microeconomic issues, which have been analyzed by considering patient-level data, leaving the relation between inappropriateness and spending at the *aggregate* level substantially unexplored. In particular, the literature claims a role for: technological changes improving the potential quality of maternity care (for instance, the possibilities to treat pain during labour, or the electronic foetal monitoring techniques); changes in patientsô characteristics (for example, the increase of the age of the mother at her first delivery); physicians and providers behaviours (clearly influenced by the payment system, but also by the fear of litigation).

Considering the aggregate level, Italy represents an interesting case study. First, at the national level, caesarean section rate has more than trebled from 1980 to 2007, from about 10 to about 40 per cent, taking Italy well above the OECD average. Unsurprisingly, the necessity to monitor its dynamics has drawn the attention of national policymakers. The 2003-2005 National

[1] As we discuss below in more details, the presence of elevated risks to child or mother health is a primary reason for a caesarean section to be an *appropriate* treatment. The evaluation of such risks heavily relies upon the quality of prenatal and maternity care. Good quality can bring to early detections of complications during birth (changes in foetal heart rates, breached birth, amniotic fluid, blood pressure and oxygen changes), hence allowing for more *appropriate* caesarean sections. On the contrary, a poor prenatal and maternity care, combined with a overly interventionist medical management,

Health Plan defined by the Italian government stated the objective of containing the average share of caesarean deliveries at about 20 per cent by the end of the planning period.[2] Over those years, however, the increasing trend in the incidence of caesarean births did not stop. Second, almost all childbirths are managed within the National Health Service, in a public or private hospital working for the NHS. Hence, the choice of vaginal versus caesarean delivery is basically a medical decision, influenced ï beyond the patient conditions ï by many organizational variables affecting providersô behaviour. Third, regional variations both in the growth rate and the incidence rate of caesarean deliveries are significant (cf. infra par. 4.3). As regions represent in Italy the level of government in charge of providing and funding (at least partially) health care services, the observed variations in caesarean section rates could be explained, at least in part, by different management practices across regional governments. For instance, caesarean deliveries are above 50 per cent and 60 per cent in Sicily and Campania respectively, two regions characterised by relatively high deficits, and where the room for cost savings is estimated to be large (e.g., Piacenza and Turati, 2014). These savings are likely to be obtained ï without reducing or limiting the quantity or the quality of health care services ï by improving appropriateness, which has been shown to be strongly correlated with the expenditure differentials observed across regions (e.g., Francese and Romanelli, 2013).

This paper addresses the issue of which factors drive the observed regional variations in inappropriateness, providing an analysis of the determinants of caesarean section rates in Italy. In particular, we study the impact of both organizational variables affecting providersô behaviour and the characteristics of regional governments on ñunwarrantedò caesarean sections, i.e., those sections that cannot be explained by legitimate causes, such as a risk to child or mother health. To do so, we follow the approach by Baicker *et al.* (2006), and try to separate ñappropriateò caesarean sections from ñinappropriateò ones, controlling for structural aggregate indicators linked to clinical factors, like the (average) motherôs age at delivery and the rate of neonatal mortality, that could make a caesarean section needed from a medical point of view. We then disentangle the impact of three groups of variables on ñunwarrantedò sections: 1) supply structure indicators, to take into account the role of different organisational arrangements of the hospital network, and the ability of different groups of producers to influence regional governments; 2) pricing policies indicators, such as the setting of DRG fees, to capture the role played by hospital reimbursement mechanisms; 3) political economy variables, catching some distinguishing

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can rise the number of *inappropriate* caesarean sections, increasing both the risks for mother and child, as well as inefficient spending.

[2] In particular, the Plan included among its objectives the decrease of the frequency of caesarean deliveries and the reduction of the regional differentials (p. 82). The stated goal was to achieve ï by the end of the three years period ï a national average equal to 20 per cent, in line with the average values for other European countries. The reduction was to be obtained also through a revision of the DRG reimbursement fees.

features of regional governments, such as the political alignment with the central government and the composition of health care funding in terms of decentralized own resources and transfers from the central government. Indeed, given a national regulatory framework constitutionally defined, health policies in Italy are implemented and managed by regions in a way that reflects a complex net of intergovernmental relationships between the central and the regional governments. And the modern fiscal federalism theory suggests that the way in which different layers of government interact affects policy outcomes.

Consistently with Baicker *et al.* (2006), our results suggest that ñappropriateò caesarean sections only partly explain regional variation in caesarean deliveries. The ñunwarrantedò residual variation appears to be related to policy choices and political economy variables: the pricing policy, the weight of different types of producers (public versus private), and the ñqualityò of regional governments are all related to inefficient spending, as proxied by caesarean sections.

The paper is linked to two different strands of literature. First, by taking an aggregate approach, it adds to patient level studies on the determinants of caesarean deliveries (see, e.g., recent examples of different approaches in Maso *et al.*, 2013a; Maso *et al.*, 2013b; Bragg *et al.* 2010; Dranove and Watanabe, 2010; Ecker and Frigoletto, 2007; Fantini *et al.*, 2006; Baicker *et al.*, 2006; Johanson et al., 2006). Second, proposing an analysis at the regional level, the present work is also related to papers on regional variations in health care and in medical practice (e.g., Skinner, 2012, and Chandra *et al.*, 2012 for recent surveys). In both cases, it emphasises the importance of the policies and the characteristics of local governments in a regional health care system as drivers of the observed variability in caesarean section rates.

The remainder of the paper is structured as follows. Section 2 provides a brief survey of the available literature on caesarean sections. Section 3 sets the stage, giving essential background information on the Italian case. The empirical strategy and the data are presented in Section 4, while the econometric results are discussed in Section 5. A brief section of concluding remarks follows.

2. Why are caesarean sections on the rise? A brief survey

According to recent statistics provided in the OECD Health Data (2011), caesarean deliveries have increased at an annual growth rate of 3.2 per cent among the OECD countries during the 2000-09 decade, reaching an average of 25.8 per cent per 100 live births in 2009. Brazil and China are the two countries recording the highest use of caesarean sections, with about half of the total deliveries. Among Western countries, Italy, the USA, and Germany are all well above the OECD average, with 38.4 per cent, 32.3 per cent and 30.3 per cent of caesarean sections per 100 live births, respectively. Given this evolution over time, it is not surprising that the impact of caesarean sections on maternal and perinatal health has drawn the attention of international organisations and national policymakers (see, e.g., Lumbiganon *et al.*, 2010 on the 2007-08 WHO global survey), as well as of academics.

Economists have been concentrated on identifying the drivers of the observed upward trend mainly taking a microeconomic approach. According to this view, many factors can help explaining the increase in the incidence of caesarean deliveries (e.g., Ecker and Frigoletto, 2007). These factors can be grouped under three main categories.

1. *Technological changes in deliveries*: these include, for instance, the shift from home to hospital delivery, the use of anaesthesia and newly improved anaesthetic techniques, the introduction of modern antibiotics, together with the creation of blood banks, neonatal intensive care units, techniques for monitoring the foetus health during pregnancy and labour, and also for inducing labour. All these factors work in the direction of making caesarean sections less risky with respect to the past, but also implies an increasing ñmedicalizationò of childbirth, which has moved the act of giving birth from a normal physiological process to a medical one, heavily involving obstetricians (e.g., Johanson *et al.*, 2002).

2. *Changes in patients**ô** preferences and characteristics*: patients might be willing nowadays to accept a lower risk of an adverse outcome to avoid a caesarean delivery. The way in which they balance and assess risk associated with the different delivery procedures could have changed also. This might reflect both social and cultural factors, as well as modifications in reproductive behaviour. In this respect, notice that the age of the mother at her first delivery has significantly increased with respect to the past, and also parents educational levels and employment statuses (particularly for mothers) have experienced dramatic variations. For instance, in Italy the average age of the mother has increased from 27.5 in 1980 to 31.6 in 2008, the share of women with tertiary education has almost trebled (from 4.9 per cent in 1993 to 12.8 in 2007), and female labour force participation has increased from 41.9 per cent in 1993 to 51.6 in 2008. Furthermore, fertility rates and householdsô size and composition are now significantly different than just a few decades ago. Again, taking Italy as an example, the total fertility rate has dropped from 1684 per thousand in 1980 to 1396.4 in 2009. The average size of the family has shrunken by 0.3 members per household (to 2.47 members) between 1994 and 2009, while the share of one-member households has increased from 21.14 per cent to 28.09 over the same period. All these factors make today (and probably more so in the future) vaginal delivery less preferred than caesarean delivery. Besides preferences, however, risk factors influence the *need* for caesarean deliveries. For instance, obesity, chronic hypertension, gestational diabetes are all clinical conditions used in the medical literature to adjust observed caesarean sections for risk, and to define the quality of obstetric care (see, e.g., recent works by Maso *et al.*, 2013a; Maso *et al.*, 2013b; Fantini *et al.*,

2006; Bragg *et al.* 2010). All these factors have deteriorated in recent decades. This is the case, for instance, of the rise in overweight and obesity, which represent one of the major health concerns in almost all countries (OECD Health Data, 2011).

3. *Changes in physicians**ô** and providers**ô** behaviour*: also the organisational characteristics of the health sector and medical best practices have displayed large changes over the last decades. Such changes are often linked to technological progress, and bring back the ñmedicalizationò of childbirth mentioned above. However, changes in physiciansô and providersô behaviours may be induced by changes in other variables. An example are the incentive effects of the payment system: if the level of the tariff relative to the costs is higher for a caesarean section than for a vaginal delivery, there is a clear incentive to supply the former instead of the latter for hospitals that can retain the difference. Hence, the organization of the health care system, the tasks assigned to public and private providers, as well as the role of regulation are all important elements which need to be taken into account when evaluating the impact of a change in the reimbursement mechanism. A second example is the change in physiciansô preferences for leisure, which may reflect the more intense use of induced labours, and the scheduling of deliveries to suit providersô timetables, in particular physiciansô and obstetriciansô work shifts. For instance, Brown (1996) examines the impact of physiciansô demand for leisure on caesarean section rates, observing that the probability of a caesarean delivery over the weekend and at certain hours of the day (and night) is significantly different (lower) than that for vaginal births. An additional issue that has received attention in the literature is the increasing fear of malpractice lawsuits, which might have influenced physiciansô decisions in promoting caesarean sections (e.g., Localio *et al.*, 1993; Dubay *et al.*, 1999; Baicker *et al.*, 2006; Johanson et al., 2006; Dranove and Watanabe, 2010). However, more recent results seem to suggest that the impact of litigation is small and short lived (Dranove and Watanabe, 2010).

Unsurprisingly, the incentive role of the payment mechanism has drawn most of the economistsô attention. Gruber and Owings (1996) investigate the impact of the exogenous shock induced on physiciansô incomes by the drop in fertility on the providersô decisions to substitute a cheaper treatment (the vaginal delivery) with one characterised by a higher reimbursement (the caesarean delivery). Such a reaction would be consistent with a model of induced demand (see, e.g., McGuire and Pauly, 1991; Chandra et al., 2012). Considering US data, the authors find a positive relation between the fall in fertility and the incidence of caesarean births, even though the impact is small (about 1/6 of the total change in the caesaren section rate). This incentive effect of fee differentials has been confirmed by other studies. Gruber *et al.* (1999) find that differences in tariffs have a positive effect on the probability of caesarean delivery for Medicaid enrolees. In particular, they estimate that the larger differentials for patients that are privately insured with respect to Medicaid enrolees accounts for between ½ and ¾ of the differential in the rate of caesarean births in the two groups. Grant (2009), replicating the analysis by Gruber *et al.* (1999), estimates a much lower impact of the tariffs (about ¼ of the one reported originally), the difference being mainly due to sample selection and the adopted estimation procedure. According to Grantǿs analysis, other factors account for most of the difference observed between the two populations, in particular risk factors and non-random matching between privately insured patients and providers which are more inclined to resort to caesarean deliveries (Grant, 2005).

3. Setting the stage: Italy as a case study

In this paper we concentrate on Italy, a country where the rate of caesarean deliveries is well above the OECD average, and where there is significant regional heterogeneity, which may also be driven by institutional aspects, since the regional governments are in charge of managing health care services. Before moving to the analysis of the factors that can play a role in the use of the caesarean delivery as opposed to the traditional vaginal delivery, we briefly describe the general institutional characteristics of the Italian health care system. According to OECD Health Data (2011), per capita total spending was 3,137 USD in Italy in 2009, slightly below the OECD average. The system is mostly public: ¾ of total spending is covered by the Italian NHS, a public universalistic scheme ï established in 1978 ï to provide all citizens a large common set of essential health care services throughout the country; the remaining ¼ is private spending, mostly out-of-pocket, which basically covers purchases of drugs and private specialists care. One of the main characteristics of the Italian NHS is the decentralisation of spending policies. The NHS involves different layers of governments, originating a complex net of intergovernmental relationships (see, e.g., France *et al.*, 2005; Turati, 2013). In particular, while funding of the NHS is (mostly) in the hand of the central government ï despite some recent moves towards a higher degree of fiscal decentralisation ï the management of the services is devolved at the regional level. Management of the services includes, for instance, decisions on the organisation of the hospital network (including the authorisation to supply for private providers), the staffing of public hospitals, as well as the definition of a whole set of region-specific tariffs within the nationally defined DRG-based Prospective Payment System. All these policies are affected by the characteristics of regional governments: health spending is the main task assigned to regions, absorbing about 80 per cent of their budgets. Especially after the electoral reform of the mid Nineties, a relevant role in steering the decision and in the management process is played by the regional governmentǿs president. The president is directly elected by citizens every five years, together with the members of the Regional Council, and has the power to appoint regional councillors on various policy areas, including health care management. Furthermore, the president can serve for an unlimited number of terms[3]; hence, health care policies with a sensitive social impact (like the decision to rationalise the hospital network) are likely to affect the probability of re-election.

Decentralisation clearly marks the differences across regions also in the supply of hospital services, which include the two types of delivery. A national reform implemented at the beginning of the Nineties tried to replicate the quasi-markets framework of the UK experience, separating the public purchasers of the services from their public providers, and allowing for some competition from private hospitals. As for public producers, the reform was fully implemented only in one region, Lombardy, while it has been only partially realised in the remaining ones, where (at least some) public hospitals are still owned by the public insurers (e.g., Turati, 2013; Brenna, 2011). The definition of both the tariffs and of the role to be assigned to private hospitals (via the authorisation process) has also been different across regional governments. As for the tariffs, not all regions decided to implement their own set of prices, but simply adopted those defined at the national level (e.g., Cantù *et al.*, 2011). As for the role assigned to private producers, this varies widely across regions as a result of different authorisation policies, and a different view of regional governments with respect to the potential benefits of competition (e.g., Pelliccia and Trimaglio, 2009). Considering official data provided by the Ministry of Health for 2010, the share of beds in private authorised hospitals is about 19 per cent on average in Italy, but this reaches 33 per cent in Calabria and 31 per cent in Campania, while it is about only 2 per cent in Liguria. Within this framework, each patient is obviously free to choose the (public or private) hospital which will provide the treatment without having to pay for the service received. The hospital (whatever the ownership, public or private) will then be directly reimbursed by the competent regional government.

In terms of maternity care, according to the latest report by the Ministry of Health (Ministero della Salute, 2013), almost all deliveries are financed by the NHS, via the supply of free hospital services (by both public and private authorised hospitals). The few privately paid deliveries are either supplied by private hospitals outside the NHS, or are home births (which, differently from other countries like the Netherlands, represent only 0.1 per cent of total deliveries). The NHS also offers pre-birth diagnostic visits, but access to services is influenced by education and by income, with more educated and rich women often substituting publicly supplied services with private care paid out-of-pocket. Within the NHS, the use of caesarean sections is higher for private hospitals than for public ones (58.3 per cent of total deliveries versus 34.6 per cent). Notice that private providers have an obvious financial incentive in preferring caesarean deliveries, since DRG tariffs are generally higher for caesarean sections than

[3] In 2004 a limit has been introduced to the number of consecutive terms which cannot be higher than two.

for vaginal deliveries[4]. Data also show a clear gradient with respect to the total number of deliveries at each hospital: the choice of caesarean sections is higher in hospitals where the number of deliveries is lower, reaching 64 per cent of total deliveries in private authorised hospitals managing less than 500 deliveries per year.

The caesarean section is of course needed in the presence of clinical reasons. The variables that have been identified as risk factors in the choice of a caesarean delivery by the medical literature based on Italian microdata (e.g., Maso *et al.*, 2013a; Maso *et al.*, 2013b; Fantini *et al.*, 2006) include both foetus characteristics (like malposition/malpresentation and weight), and mother characteristics (like ante-partum haemorrhage, APH, umbilical cord prolapse, UCP, but also age, past experience of a caesarean section, and lifestyle habits). However, the literature makes clear that, even controlling for these risk factors, differences across hospitals still persist. As observed by Maso *et al.* (2013b), this means that there are variations in clinical evaluation and management of risk factors in deliveries. These variations might be related either to differences across care givers (for instance, different physicians might evaluate dystocia in different ways), or to differences in hospital practices and organization. While the study is limited to one small autonomous region in the North-Eastern part of the country (Friuli Venezia Giulia), it can be assumed ï considering for instance studies discussed in Chandra *et al.* (2012) ï that variability *across* regions is also related to variability in care givers behaviour and organization.

Behaviour and organization of hospitals is certainly linked to the characteristics of regional governments and their policy choices, for example in terms of tariffs and the size of hospital network. But despite the relevance of caesarean sections, contrary to the USA, economic studies on Italy are quite rare. Pizzo (2008) highlights a significant difference in the national reimbursement fee between vaginal and caesarean delivery in the Italian DRG payment system, but she does not provide any estimate of the impact of fee differentials on the probability to observe a caesarean birth. After noting the wide regional variation in caesarean delivery rates, Pizzo attempts at assessing the potential savings that would have been observed had the caesarean section rate been fixed to a given reference value (like, e.g., the one proposed by the WHO). Savings are shown to be substantial (about 10 per cent of total expenditure for deliveries). Fabbri and Monfardini (2008) consider the issue of assortative matching between mothers and two types of providers, public and private hospitals, with the latter being characterised by a higher (unconditional) inclination to resort to a caesarean section. According to the authorsô findings, the assortative matching between patients and providers is of minor relevance: the selection mechanism of patients into hospitals is largely driven by risk factors, with the more risky patients

[4] According to recent data made available by the Ministry of Health, considering national DRG tariffs used for compensating mobility of patients across regions, the difference is more than 1 thousand euro, being the tariff for caesarean

being admitted into public hospitals, which can be considered of higher quality with respect to private providers, since the latter often do not have emergency surgical capacities or intensive care units. Indeed, after controlling for selection and other observable characteristics, the conditional probability of resorting to a caesarean delivery is still higher in private hospitals than in public ones. A finding that leaves the issue concerning the effects of financial incentives open. In what follows we provide a first attempt to fill the gap, by providing a regional level evaluation of the importance of financial incentives, the supply structure, and ï more generally ï the ñqualityò of regional governments in charge of managing health care policies for explaining the rapid increase observed in caesarean deliveries.

4. The empirical strategy

4.1. Model specification

To test the impact of different groups of variables on the caesarean section rates, we consider the following multivariate specification:

$$y_{it} = \alpha + \alpha_i + \sum_{t=1}^{T} \beta^t d_t + \sum_{j=1}^{J} \beta_j^x x_{it}^j + \sum_{f=1}^{F} \beta_f^w w_{it}^f + \sum_{k=1}^{K} \beta^k k_{it}^k + \sum_{h=1}^{H} \beta_h^z z_{it}^h + \varepsilon_{it} \qquad (1)$$

where the dependent variable y_{it} is the (ln of the) odds ratio of caesarean deliveries in region *i* in year *t*. In the light of the previous discussion, covariates are grouped into four categories:

[*a*] *control* variables x_{it}^j (*j* = 1, é , *J*), such as demographic characteristics of patients (e.g., mothersô age) and their education, and other factors to capture the riskiness of births. These variables should proxy both the patientsô preferences and the clinical risk factors which make caesarean deliveries necessary. In this sense, they are meant as proxying for a predicted probability of caesarean sections, in the attempt of separating ñappropriateò sections from ñinappropriateò ones[5];

[*b*] *supply* indicators w_{it}^f (*f* = 1, é , *F*), such as the workforce composition and the incidence of private providers, in order to control for organisational and structural differences which could influence physiciansô choices;

sections ú 2457.72, and the one for standard vaginal delivery ú 1318.64.

[5] The concept of ñappropriatenessò is defined according to Baicker *et al.* (2006) and should be interpreted as ñmedical appropriatenessò. At the aggregate regional level, this means that we are identifying a number of births that «are collectively viewed by doctors as being better candidates for a caesarean» (again, Baicker *et al.*, 2006). This is of course an approximation and a clear limitation of the present study. As discussed in the medical literature, the recourse to a caesarean section can be made necessary by clinical conditions arising during labour. For instance, Lieberman and OôDonoghue (2002), in their review of studies on the unintended effects of epidural analgesia, suggest that the use of epidural is associated with a lower rate of spontaneous vaginal delivery, particularly in nulliparous women, which might originate the need for a caesarean section.

[*c*] *pricing policy* indicators k_{it}^{k} (k = 1, é , K), in particular the presence of a region-specific complete set of DRG fees for the reimbursement of hospital services;

[*d*] *political economy* indicators z_{it}^{h} (h = 1, é , H), such as the political orientation of the regional government with respect to the central one, the importance of decentralized own revenues to finance current health spending, and the years of experience of the regional president. All these variables should capture the influence of regional governmentsô institutional features on caesarean section rates and health care inappropriateness;

[*e*] we also include regional (α_i) and year (d_t) dummies in order to control for *space and time fixed effects*, respectively.

Statistical inference from the model presented in Equation (1) can be influenced by two different sources of bias: spatial correlation, due to the presence of possible strategic behaviours among regions driven by geographical proximity, and serial correlation, due to the clear upward trend characterising the growth of caesarean rates. We take into account both these issues when estimating our model (see Section 5.1 below for a discussion).

4.2. Data and variables

Equation (1) is estimated on the sample of all Italian regions over the years 1998-2005[6]. We consider both Ordinary and Special Statute regions, including the two Autonomous Provinces of Trento and Bolzano, for a total of 21 units observed for 8 years. Descriptive statistics for all the variables used in the empirical analysis are reported in Table 1.

Control factors are drawn from the *Health for All* dataset provided by Istat (the National Institute of Statistics), and are all available at the regional level. They include: an indicator for motherôs age, defined as the average age of the mother when giving birth; the birth rate, i.e., the number of childbirths per 1,000 people; the share of women with only primary school education; the neonatal mortality, i.e., the number of deaths within the first 6 days of life per 10,000 live-born babies, which is meant to proxy for other clinical risks that can influence the need for caesarean delivery.[7]

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[6] The sample period starts in 1998 since the DRG prospective payment system has been introduced and the tariffs decided at national level in 1997. In this way, the comparison of performances in caesarean deliveries across regions is carried out under a common national regulatory framework for the reimbursement of hospital costs, which allows to better identifying the role played by differences in regional policies (notice that extending the analysis to include the year 1997 delivers results in line with those discussed below). Moreover, the years considered here are those for which the information is available for all the variables included in the estimated models.

[7] As mentioned in Section 3, the medical literature based on patient level data (for sub-samples of the Italian population) suggests that many factors are linked to increased use of caesarean deliveries, such as particular clinical conditions that may happen during the pregnancy (cord prolapse, malpresentation, etc.), maternal comorbidities (as diabetes, heart diseases, etc.), and lifestyle habits (such as smoking or being overweight); see, for example, Stivanello *et al.* (2013) and Maso *et al.* (2013a,b). However, detailed data (or indicators) for these factors at aggregate regional level are not fully available. Therefore, it is not possible to pursue the strategy of including all these controls. Moreover it should be noted that the inclusion of a comprehensive set of risk indicators is less relevant in an aggregate framework than in a micro-

Table 1 ï Descriptive statistics: sample of all Italian regions over the years 1998-2005

		# obs	mean	std. dev.	min	max
	% caesarean deliveries	168	33.154	9.470	14.120	59.950
dependent variable	ln odds ratio of caesarean deliveries	168	-0.730	0.430	-1.805	0.403
control variables (x)	mother's age	168	30.737	0.727	28.600	32.060
	birth rate	168	9.178	1.183	6.900	12.230
	% primary school education (females)	168	17.718	3.210	10.083	25.133
	neonatal mortality (first 6 days)	168	10.905	4.755	0.000	25.580
supply indicators (w)	medical staff (% of total NHS employees)	168	54.723	3.237	47.031	59.612
	beds in private hospitals (ratio)	168	11.749	8.439	0.000	35.051
pricing policy indicators (k)	regional tariffs (dummy)	168	0.292	0.456	0.000	1.000
political economy indicators (z)	in line with central government (dummy)	168	0.494	0.501	0.000	1.000
	share of own funding	168	0.367	0.149	0.065	0.728
	president gender (dummy)	168	0.958	0.200	0.000	1.000
	president experience	168	3.280	3.145	0.000	15.000
	president is a doctor (dummy)	168	0.089	0.286	0.000	1.000

Sources: dependent variable, controls and supply indicators are drawn from Istat ï *Health for All*, and from publications by the Italian Health Ministry; pricing policy variables are built from information drawn from Agenas and Carbone *et al.* (2006); political economy variables are computed from data published by the Italian Ministry for Domestic Affairs.

Supply indicators for the structural characteristics of the hospital sector are published by the Italian Health Ministry. We consider two variables here: the share of beds in private hospitals out of the total regional supply of beds, to control for the ñpreferenceò of private hospitals for caesarean sections with respect to vaginal deliveries; and the relative size of the medical staff (including both physicians and nurses), as a percentage of the total number of employees in the regional health service (the remaining employees being mainly managers, administrative staff and other technical positions), to capture potential effects of demand induction[8] and, more generally, the impact of organisational choices on the outcome of the services.

As for the pricing policy adopted in each region for hospital services, we build different variables starting from available information provided by the *Agenzia Nazionale per i Servizi*

oriented analysis: over a relatively short time span (as the 8-year period considered in our analysis) it is likely that the geographical distribution of risk factors remains substantially stable, so that any residual riskiness (besides that captured by the age of the mother and neonatal mortality rate) is absorbed by fixed effects and time dummies. Such conclusion is supported by data published by Agenas in the framework of the Programma Nazionale Valutazione Esiti (PNE), which are referred to primary caesarean rates. The database reports raw and risk adjusted caesarean rates for (almost) all the (public and private) hospitals that work with the NHS. The data are however available only for the years 2007-2012, and do not overlap with our sample period (so that we cannot use risk adjusted caesarean rates as a dependent variable). However, they show that the degree of correlation in each year between the regional distribution of raw and risk adjusted rates is very high (between 0.96 and 0.98), suggesting that the remaining bias in our dependent variable is not so severe as one might think, since we control for one of the main demographic factor for riskiness (the age of the mother) and neonatal mortality.

[8] An additional factor which can influence demand induction is the fear of lawsuits. We are unable to control for regional differences in malpractice and related consequences. Notice, however, that Italian legislation assigns to Regions also the choice of whether to cover the risk (at least partly) with a public fund, or to buy coverage on the insurance market. Our fixed-effects specification should then help capture also this factor, which is however found to exert a small and short-lived impact in the literature (Dranove and Watanabe, 2010).

Sanitari Regionali (Agenas, literally the National Agency for Regional Health Services) and the reconstruction presented in Carbone *et al.* (2006). In particular, we consider a dummy variable equal to one when regional governments set their own complete set of DRG tariffs different from the national standards as established by the decree DM 30.06.1997.[9] We expect governments that implemented a system of region-specific tariffs to be *more active* in the management of health care services, hence more attentive in expenditure control and in reducing ñunwarrantedò caesarean sections. As the new tariffs can require some time to be effective, we also define a dummy picking up the year in which each regional government has introduced its own DRG fees (if they have decided to do so). We finally interacted these two variables with the share of beds in private hospitals, expecting a different impact of pricing policies according to the relevance of private producers. In particular, we expect that ï where the share of private providers is substantial ï these can try to lobby regional governments to obtain a more profitable tariff regulation, which may turn into a higher degree of inappropriateness in spending.

Political economy indicators are built upon information published by the Italian Ministry for Domestic Affairs, or directly requested to regional administrative offices. These include two variables capturing characteristics of regional governments that reflect their relationships both with the central government and the citizens-voters, which have been interpreted in the literature as important factors influencing efforts by sub-national governments in controlling decentralized expenditure and inefficiencies (e.g., Arulampalan *et al.*, 2009; Bordignon and Turati, 2009; Boetti *et al.*, 2012; Piacenza and Turati, 2014). As for the relationship with the central government, we look at the political alignment between central and regional government, by building a dummy equal to one when the political orientation of the two levels of government is the same. As governments in Special Statute regions are formed by local autonomist parties, we checked the political alignment for each of these by considering affiliations at the central level. We classified as left (right) oriented the autonomist parties forming majorities at the central level with left (right) wing parties. According to the available literature, the alignment between central government and regional government can result either in a virtuous ñhelp outò effect ï according to which politically aligned regions cooperate with central government in controlling health expenditure and deficit ï or in an opposite ñbailout expectationò effect ï according to which the regions hope to receive a more benevolent treatment in terms of ex-post funding by a ófriendlyô central government than by an adversary one.[10] As for the relationship with citizens-voters, we consider a variable measuring the degree of vertical fiscal imbalance (VFI), defined as the ratio

[9] One could also have considered the relative tariff of caesarean sections with respect to vaginal delivery for each region and each year of the sample. Unfortunately, these data are not available at the Agenas, and Regional governments are not keen at providing such information, so that we were able to collect only very partial information that can not be exploited in our estimations.

between regional own funding and public health expenditure. Regional own revenues follow the classification proposed by the Ministry of the Economy in the *Relazione Generale sulla Situazione Economica del Paese* (General Report on the Economic Situation of the Country), and include mostly regional taxes like the Irap (i.e., a regional tax on productive activities), and the regional surcharge on Irpef (the Italian personal income tax). According to modern fiscal federalism theory (e.g., Qian and Weingast, 1997; Weingast 2009), focusing on the incentives towards electoral accountability of government officials and identifying fiscal decentralization as a disciplining device for local politicians, we expect that the lower the share of decentralized own resources, the higher the degree of VFI, the lower the electoral accountability of regional government, hence the higher the inappropriateness of public health spending.

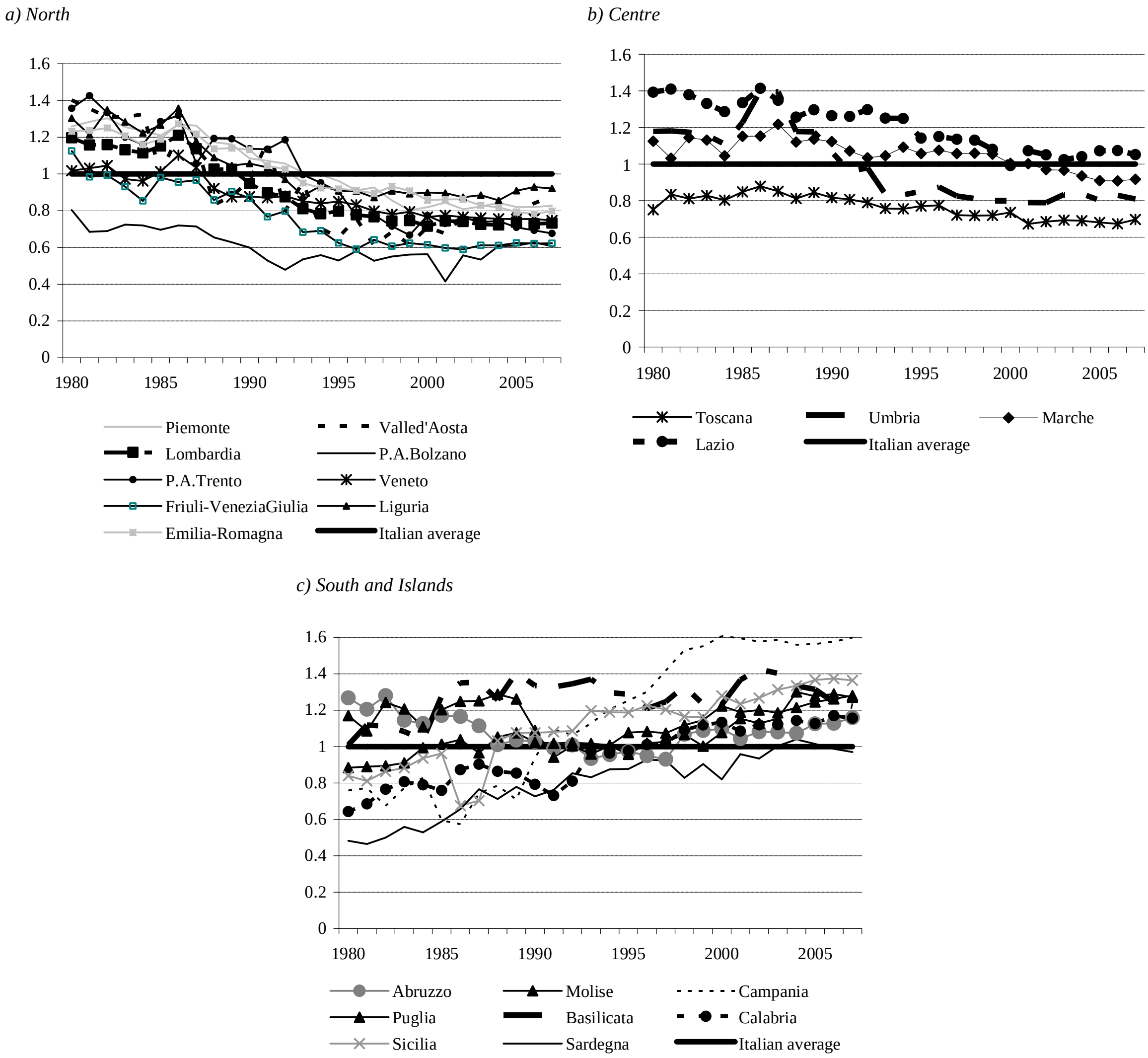
Given the prominence of the governor in policy making for health care, we also enrich the analysis of the role played by political institutions by defining three variables capturing important features of the regional governmentô president: the gender (a dummy equal to zero in case the president is a woman), to control for the specific care women may have for the issues related to health care in general, and for delivery in particular (see, e.g., Chattopadhyay and Duflo, 2004); the experience (a variable measuring the number of years the president has been in office), expecting a more experienced governor to be more able to effectively control spending, in the light of the issue of management capacity building (see, e.g., Honadle and Howitt, 1986); the occupation (a dummy equal to one in case the president is a physician), to control both for the particular attention a doctor can have for health care in general, and for the technical knowledge he might exploit in favouring different types of deliveries and in managing regional health care services.

4.3. Preliminary evidence on caesarean deliveries in Italy

With respect to trends registered at the international level, the increase in the share of caesarean deliveries in Italy has been remarkable: on average, at the national level the caesarean section rate increased from 12 per cent in 1980 to 37 in 2007 (from 29 to 37 per cent in the sub-sample period 1998-2005 considered in this paper; see footnote 6). However, its dynamics showed significant regional variations. After a period of convergence in the eighties, since the nineties developments have been differentiated across regions. In particular the coefficient of variation has increased from 0.19 in 1991 to 0.28 in 2007 (0.28 is also the average coefficient of variation observed in our sub-sample). These developments have shown a clear geographical pattern (Fig. 1, panels a, b and c). The regions in the North and Centre were characterised by significantly lower growth rates in the use of caesarean sections than those experienced in the South.

[10] For further discussion on this issue see, in particular, Arulampalan *et al.* (2009) and Bordignon and Turati (2009).

Figure 1. Caesarean deliveries in the Italian regions normalised with respect to national average



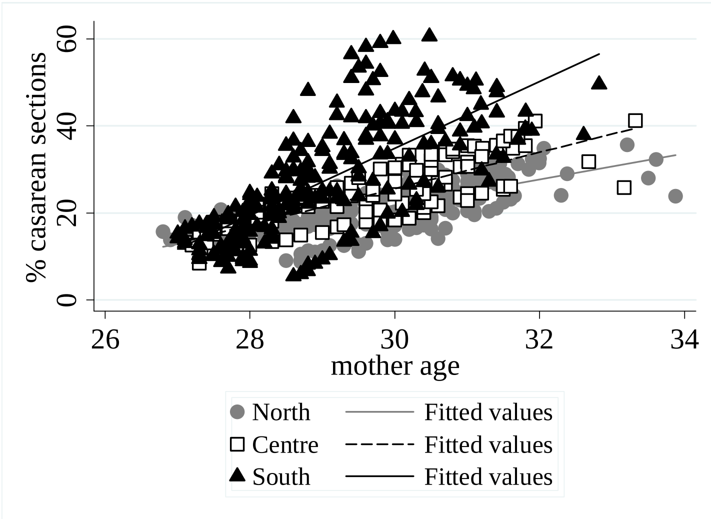
Sources: our computations on Istat, Health for All.

Of course, unconditional means might simply reflect different changes in regional populations. A first glance at the data shows that the more frequent use of caesarean sections was in fact accompanied by changes in patientsô characteristics across regions and time. For instance, the correlation between the incidence of caesarean births and the number of patients with complications at delivery is positive. The same is true if one considers motherôs age, which rose considerably over the last decades in almost all regions. But the impact of changes in patientsô characteristics is different in the different areas of the country (Fig. 2).[11] A simple OLS regression of the incidence of caesarean deliveries on motherôs age shows a positive relation between the

[11] Figure 2 presents a scatter plot analysis of the incidence of caesarean sections and the average motherôs age in each region (independently of the year to which the data refer). It shows that higher motherôs age is generally associated to a more frequent use of caesarean deliveries.

two variables, which at least partly reflects a time trend in the age of the mothers in all the areas of the country. However, it also highlights a statistically significant difference in the coefficient between the South (for which the estimated coefficient is higher) and the rest of the country, while differences between the regions in the North and the Centre are not statistically significant. The different reaction to patientsô characteristics across regions raises the question of what other institutional or policy determinants can account for such evidence, which is the focus of the paper.

Figure 2. Incidence of caesarean sections and mother age by macro area



5. Estimation results

5.1. Methodological issues: serial and spatial correlation

As a baseline approach, we estimate Equation (1) using a panel fixed-effect estimator. We performed a Hausman test comparing fixed and random-effect estimators; the results suggest the use of the former. Table 2 compares estimation results for a baseline model including structural controls only (column A) with those obtained from augmented specifications adding the other three groups of variables listed above (columns B-E). In general, the sign of the coefficients and their significance levels are quite robust across model specifications. Region-specific fixed effects are significant: the geographical pattern confirms the descriptive evidence discussed above, with Northern regions displaying, *ceteris paribus*, a lower odds ratio.

We tested the adopted specification and estimation strategy in several ways. In particular, we controlled for two kinds of problems: serial and spatial correlation. Concerning serial correlation, we performed two tests. While the Wooldridge (2002) statistics does not reject the hypothesis of no serial correlation, the Bargava *et al.* (1982) modified DW suggests the presence of serial correlation. Therefore, for all estimated specifications robust standard errors (clustered by regions) are provided. Furthermore, we extended the model to include time lagged regressors, to check for the presence of a dynamic dimension of the model which could be due to time persistence in agentsô behaviour. However, none of these additional regressors turned out to be significant, so that we consider a static model.

As for the issue of spatial correlation, we recognize that in a decentralised setting ï such as regional governments in Italy ï the economic policies of neighbouring jurisdictions may show a certain degree of correlation, as highlighted by several empirical studies in many different countries (e.g. Brueckner, 2003). Interactions among regional governments can be the result of a political strategy. From a theoretical point of view, assuming the presence of private information about either the quality of the incumbents or the costs and benefits of the policies implemented (e.g., Salmon, 1987, Besley and Case, 1995), citizens can get some insights by comparing the performance of their politicians with the performance of politicians in neighbouring jurisdictions. As a consequence, when making their choices, incumbent governments would have an incentive to consider the policies in neighbouring jurisdictions ï especially those related to sectors with a clear impact on citizensô wellbeing, such as health care ï in order to maintain political consensus.

To account for these potential effects, we estimated a spatial panel fixed effects model (Table 2 ï column F) that allows to test both for spatial lag and spatial error correlation (Anselin, 1988). The analysis considers the complete set of covariates included in the model in Table 2, col. E (including time dummies). The weighting matrix was computed on the basis of the Euclidean distances between the capitals of the regions[12]; we considered a row standardised version of the matrix. Tests for spatial correlation suggest that the hypothesis of the absence of spatial correlation in the error term cannot be rejected, while they indicate that negative lagged spatial correlation is statistically significant.[13] This implies that higher caesarean section rates in neighbouring regions are associated with lower rates in the region under consideration. There are at least two possible explanations for this negative sign: on the one hand, considering the need for caesarean sections, a negative spatial lag might be related to high risk patientsô mobility, since highly specialised paediatric hospitals recognized by the Ministry of Health are located in just

[12] Distances have been calculated using the Google maps distance calculator. This tool measures distances ñas the crow fliesò.

[13] Tests also suggest that the absence of additionally lagged spatial correlation both in the dependent variable and in the error term cannot be rejected. To verify the results offered by the spatial fixed effect model we also proceeded to separately estimate a lag and error version of the model using standard spatial estimators and including regional and time dummies in all the specifications. Such additional analysis also suggests that spatial correlation in the error term is not a significant issue.

half of the twenty regions.[14] On the other hand, considering ñunwarrantedò caesareans, a negative spatial lag could be the sign of caesarean deliveries being a strategic substitute in regional governmentsô policies: for a given rate in neighbouring regions, there is an incentive for regional governments to reduce their use in order to signal to their citizens their commitment toward spending efficiency. Overall, however, the spatial model confirms the magnitude, sign and significance of the coefficients obtained in the full baseline regression (column E). Table 3 reports estimated coefficient of the spatial panel fixed effect model; since the dependent variable is the (log of the) odds ratio of the caesarean deliveries, the table also presents the transformed coefficients in terms of (more easy to read) percentages of caesarean deliveries. Given the adopted specification and the estimation results, total marginal effects for the spatial model can also be computed. They confirm the sign and magnitude of the effects of the variables of interest provided by the baseline model.[15] Table 4 displays summarising results ï total, direct and feedback (stemming from the spatial lag dynamics described above) marginal effects ï that have been computed as averages (over the regions) of the marginal effects on the dependent variable in region *i* with respect to variable *r* in the same region.[16]

On the basis of this set of estimates, we can therefore proceed with the discussions of the main results concerning the role played by the different factors determining the choice of caesarean deliveries.

5.2. The determinants of caesarean sections rates

Considering *control* variables first, we find that ï as expected ï the effect of motherôs age is positive and statistically significant, meaning that older mothers at time of giving birth are associated with a higher (and, probably, ñmedically appropriateò) number of caesarean sections. On the contrary, the impact of the birth rate is negative and significant. This result is in line with the findings in Gruber and Owings (1996), suggesting that a drop in fertility is accompanied by an increase in caesarean sections. The interpretation proposed by the authors ï reflecting the US experience ï is that a decline in hospital revenues (due to the reduced number of births) triggers a substitution between vaginal births (reimbursed at a cheaper rate) and caesarean births (which are paid at a higher tariff). However, another possible explanation for the negative impact of the birth rate on caesarean deliveries, especially in a mostly public health care system like the Italian one, may be the presence of a ñlearning effectò, i.e., the greater experience gained by the hospitals

[14] These include almost all the regions in the North; Lazio, Toscana and Marche in Central Italy; Campania in the South; and both the Islands, Sicily and Sardinia.

[15] The spatial model is presented in the Appendix, which also describes how marginal effects and elasticities can be derived from the specified model. Tables with detailed results for some of the variables of interests are also provided in the Appendix. The full set of marginal effects and elasticities can be provided upon request.

[16] The detailed description of the total, direct and feedback marginal effects is included in the Appendix.

when the number of births increases, which should imply a reduced *need* for caesarean sections. This second interpretation is in line with the available descriptive evidence, that shows an higher use of caesarean deliveries the lower the number of births in a hospital (Ministero della Salute, 2013). We also take into account a measure of the underlying riskiness of births, which could be a factor of a more intense use of ñappropriateò caesarean sections. In particular, following Gruber and Owings (1996), we include as a regressor the neonatal mortality rate within 6 days.[17] The estimated coefficient for neonatal mortality is indeed positive, suggesting that caesarean sections increase with riskiness.[18] Finally, we control for the education level of (potential) mothers, by considering the share of females holding *only* a primary school diploma (thus picking up the share of women with a very low level of education, those probably more prone to decisions taken by physicians). The estimated coefficient is positive, but significant only in the spatial fixed effect model. Therefore, in general, differences in average education do not significantly affect the use of caesareans. However, the positive sign suggests that, ceteris paribus, women with only elementary schooling display a higher use of caesarean sections, hence they are likely to be more inclined to incentives affecting providersô behaviour and influencing variations in medical practice (e.g., Chandra *et al.*, 2012).

As for *supply* indicators, the incidence of medical staff on the total number of employees positively affects the number of caesareans. Also the coefficient for the share of beds in private hospitals is positive, but never statistically significant.[19] There are two explanations for these findings: first, supply indicators are in general quite ñstickyò over time, particularly so over a short time span like the 8 years used in our study; hence, their effect is picked up by regional fixed effects. Furthermore, these variables refer to the generality of health services, and are not specific to gynaecology/obstetrics wards. They are meant to reflect overall management and policies in the health care sector, in line with the objective of considering the incidence of

[17] The neonatal mortality rate is defined as the fraction of live births that die within 6 days. Our results are however confirmed also using the neonatal mortality rate at 29 days. Notice that neonatal mortality could be influenced by the choice of caesarean sections: on the one hand, an ñappropriateò use of caesarean sections could reduce mortality; on the other hand, a poor quality of prenatal care could increase mortality, not making use of a caesarean section when needed. To check the robustness of our results to this potential endogeneity problem, we have also run the specifications reported in Table 2 columns A-E using lagged values of this indicator. All our results (coefficients and significance levels) remains substantially unaltered with respect to those reported in Table 2, and lagged neonatal mortality turned out to be never significant.

[18] As for the underlying riskiness of delivering, in order to partially control for the factors highlighted by the medical literature (see Section 3 and footnote 7), and to further test the robustness of our specification, we have also estimated extended models which include additional control variables. In particular, we considered two indicators built upon information on the main comorbidities and/or lifestyle factors at regional level for the female population. Coefficients estimated for the new indicators were never significant, while the others were substantially unaffected (in sign, magnitude and significance), thus suggesting that the baseline specification adopted here satisfactorily takes into account birth riskiness.

[19] We also controlled for a measure of use intensity of hospitals facilities (average stay in hospital). The variable is not significant and affects neither the magnitude nor the significance of the other coefficients. Similarly, including the ratio of beds on population (as a measure of productive capacity) yields a non significant coefficient and does not alter the other findings.

caesarean sections a proxy for the extent of inappropriateness/inefficiencies in the provision of health services in each region.

Looking at *pricing policy* indicators, the dummy variable accounting for the *presence* of regional own tariffs has a negative impact on the number of caesarean deliveries (columns C-F; total marginal effect for the spatial fixed effect model is reported in Table 4). Our interpretation for this result is that regions adopting a whole set of region-specific DRG tariffs are putting effort in managing health expenditure using available policy tools. When interacting the dummy for the presence of regional DRG tariffs with the relative size of the private hospital sector, we find a positive coefficient for the interaction term, implying that the reducing effect on caesarean sections stemming from the active management of reimbursement tariffs is mitigated (or even reversed) the higher the relevance of private hospitals (Fig. 3).[20] A likely interpretation is that, where the share of private providers is particularly large, lobbying efforts by these providers aimed at obtaining more favourable tariffs offset the efforts of regional governments in defining a pricing policy aimed at controlling inappropriateness and spending inefficiencies. We also find a positive impact for the dummy variable accounting for the *introduction* of regional tariffs (which takes on value 1 only the year DRG tariffs were adopted), which would suggest the possible presence of some ñadjustment costsò. Similarly, its interaction with the share of beds in private hospitals ï included to capture the incentives of these providers to reduce ñadjustment costsò, in order to exploit more rapidly the benefits associated with the new tariffs ï shows a negative and significant coefficient.

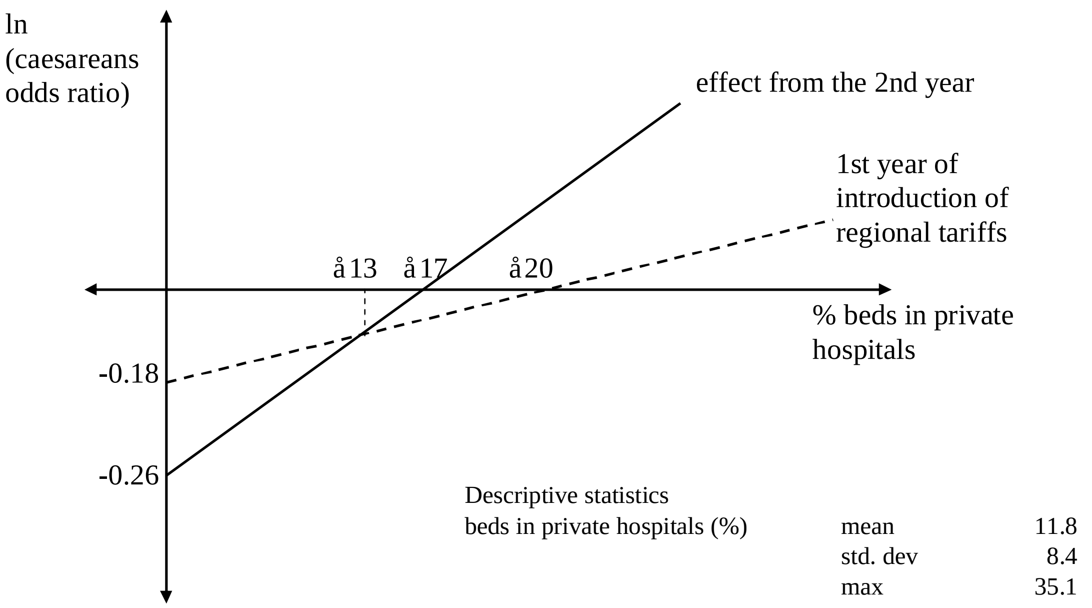
An important issue that is worth discussing here concerns whether these estimated effects represent causal relationships, i.e., our pricing policy indicators may be interpreted as actual determinants of the variability observed in caesarean rates. Indeed, it may be that decentralized DRG fees are put in place by regions as a consequence of high levels of inappropriate spending so as to reduce it, which would make these variables endogenous (e.g., Dafny, 2005).[21] Although we recognize the potential importance of this problem, there are at least three arguments supporting the view that our pricing policy indicators are reasonably exogenous. First, even though in general we agree that defining regional fees can also aim at improving the appropriateness in health care services (e.g., Cantù *et al.*, 2011; Morandi *et al.*, 2008), our dependent variable refers to a particular treatment ï birth delivery using a caesarean section ï which, even if assumed to be a proxy for spending appropriateness, it is unlikely to be the only factor affecting the decision to introduce region-specific DRG fees for the *whole* set of health

[20] For example the estimates for specification E in Tab. 2 imply that when the share of beds in private hospitals is larger than 17 per cent the introduction of regional tariffs does result, all other things being equal, in an increase in the odds ratio of caesarean deliveries.

[21] We acknowledge an anonymous referee for raising this issue.

care services.[22] Second, while the regions can introduce own DRG tariffs to make the price system closer to their actual costs and local specificities, there is usually a certain lag (two years or more) between the collection of production data and the year in which they are used to set prices (e.g., Fattore and Torbica, 2006, for Italy; Januleviciute *et al.*, 2012, for Norway). Finally, there are other important decisions taken by regional government concerning the health care policy ï e.g., the overall organisational arrangement of hospitals, the introduction of expenditure caps, ceilings and targets, the definition of services to be financed through lump sum transfers ï which exhibit different features across regions and affect the adoption of a specific tariff system besides the role played by actual costs.[23] All in all, relying on the above arguments, variations observed in pricing policies across regions can be therefore considered to be pre-determined and the estimated effects of region-specific DRG fees discussed above interpreted as causal relationships.

Figure 3. Graphical representation of the results on regional DRG tariffs (Table 2 ï column E)



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[22] Indeed, as remarked in Morandi *et al.* (2008), in order to provide the correct incentives to improve appropriateness, the regional tariffs should be defined so as to reflect production costs and in accordance with the perceived need of increasing or reducing the provision of each health treatment, thus resulting in deviations (upward or downward) from national DRG fees differentiated across services. It is worth noticing that a similar argument supporting the exogeneity of our regressors with respect to caesarean rates applies also when considering potential endogeneity problems for supply indicators ï see the above discussion about the share of beds in private hospitals and its dependence on the generality of health care services ï and, a fortiori, for political economy factors, as regional governmentsô and presidentsô characteristics possibly reflect overall management and policies related to many other services besides health care.

[23] See, e.g., Cantù *et al.*, 2011; Finocchiaro Castro *et al.*, 2014. In particular, these authors have pointed out that, while in Northern and Central regions DRG fees are consistently used to provide cost incentives to producers, in Southern regions such a role is weakened by the coexistence with other funding criteria such as past and current expenditure and deficits. These differences across regions are captured by regional fixed effects.

Finally, considering the role played by *political economy* factors (columns D-F), we find that some characteristics of regional governments do indeed matter. We look first at the effects of the two variables capturing the relationships with the central government and the citizens-voters. While the political alignment *per se* appears to have no influence on caesarean sections (even if, as discussed below, it has a significant impact when considered together with the presidentôs experience), the coefficient for the share of own regional resources on total health spending shows a negative sign and it is statistically significant: the lower the degree of VFI, the lower the share of caesarean sections, hence the inappropriateness of health care services. As the institutional rules governing own resources in Special Statute regions are different from those in Ordinary Statute ones, we also interact our proxy for VFI with a dummy identifying Special Statute regions. However, coefficient for this interaction term turns out to be neither statistically significant nor altering the magnitude of the other coefficients, probably because of the presence of regional fixed-effects already accounting for differences in the institutional framework. This inappropriateness-reducing effect is consistent with two different interpretations. First, in line with modern theories of fiscal federalism (e.g., Weingast, 2009), a higher degree of fiscal autonomy determines higher electoral accountability, leading to a tighter control on government spending and increased cost efficiency. From this perspective, our result adds to recent empirical literature investigating how tax decentralization and VFI affect local government size using a different indicators of inefficient spending (e.g. Jin and Zou, 2002; Borge and Rattsø, 2008; Eyraud and Lusinyan, 2011; Boetti *et al.*, 2012; Liberati and Sacchi, 2013). Second, regional differences in the share of decentralized funding mostly reflect tax base distribution across the country (e.g., De Matteis and Messina, 2010), and might then capture North-South inequalities in per capita GDP, which impact indirectly on the use of caesarean sections via patientsô preferences, beyond our control for mothersô education.[24]

As for the individual features of the regional governor, we find that the coefficient for presidentôs experience (measured by the number of years the president has been in office) is negative and statistically significant, suggesting that a more experienced president helps containing the caesarean section rate, which is one indicator along which the Ministry of Health monitors the performance of regional governments. This positive impact of experience on performance is probably due to the ability of a more experienced governor to make policy choices to work effectively. For instance, more experience can facilitate a regional monitoring

[24] One could argue that the variability in VFI may also pick up differences in health care needs across regions, which result in changes in health expenditure for a given level of own resources. To this regard, the analysis of health spending of the Italian regions over the period 1993-2006 carried out in Piacenza and Turati (2014) pointed out that the increase in health needs is associated with a lower spending inefficiency, thus implying that the resources seem to be better allocated in regions where illnesses are particularly difficult to treat. This evidence corroborates our interpretation of a lower VFI as a factor associated to a reduction in health care inappropriateness.

activity on hospitalsô behaviour, or the bargaining process with hospitalsô manager in the case of decisions affecting the hospital network. The result is in line with recent findings of the literature on electoral discipline of the duration of legislative terms, which points out that longer terms tend to improve the performance of governments (e.g., Dal Bó and Rossi, 2011). However, when interacting the presidentøs experience with the dummy capturing the political alignment between regional and central government, we find a positive and significant coefficient. Hence, the positive effect stemming from experience vanishes in the case of presidents politically aligned with the central government. As discussed, e.g., by Arulampalan *et al.* (2009), this finding can be interpreted in terms of increased presidentøs expectations of a more ñbenevolentò treatment (for instance, in terms of deficit bailout) by a friendly central government than by an adversary one. We also control for the type of presidentsô occupation before entering politics, defining a dummy equal to 1 when the president is a physician. Coefficient for this variable is positive and statistically significant. One possible interpretation is that physicians are likely to be more sensitive to lobbying from the health care sector, and implement a weaker regulation; in turn, this is reflected in a higher level of inefficiency and inappropriateness. Additionally, governors from medical professions can simply decide to respect medical autonomy and medical influence on childbirth, increasing discretional choices by obstetricians and physicians.

6. Concluding remarks

A recurrent policy suggestion to control health spending growth while guaranteeing adequate level of services to citizens is to reduce inappropriateness. In this paper we exploit the rate of caesarean deliveries as a proxy for inappropriateness and the Italian regional health care system as a case study: on the one hand, there is evidence of large differences in the use of caesarean sections across different regional governments, those in charge of managing health care services in Italy. On the other hand, the literature emphasizes a positive link between inefficiency in the production of health services and inappropriateness of treatments, so that reducing inappropriate services would imply cost savings for the public purse. The problem is sizeable: recent controls on the information included in the patientsô discharge records conducted by the Italian Ministry of Health pointed out that 43 per cent of the caesarean sections executed in 2010 are likely to be unwarranted according to clinical conditions. Back-of-the-envelope calculations by the same Ministry of Health suggest that this percentage of inappropriateness would imply for the Italian NHS potential savings of about 80-85 million euro per year, about 10 per cent of the yearly expenditure for deliveries.[25] Our aim is to study how inappropriateness is affected by variables

[25] The brief note with the results of these controls is available at the web site: http://www.salute.gov.it/portale/news/p3_2_1_1_1.jsp?lingua=italiano&menu=notizie&p=dalministero&id=914.

capturing both the policies implemented by regional governments (like the supply structure of hospital services, and the choice of region-specific tariffs), and the characteristics of regional governments (like their political alignment with the central government, and the experience of the regionôs president). To this end, we try to separate ñappropriateò treatments (taking into account control variables like the motherôs age and the riskiness of births, which should capture medical reasons to opt for a caesarean section), from ñinappropriateò ones.

Our estimates on the complete set of Italian regions over the years 1998-2005 suggest that these regional variables do indeed matter. As for regional policies, while we find no significant strong direct effects for supply indicators, our results imply that the adoption of a complete set of region-specific DRG tariffs could be an effective policy tool to control inappropriateness. However, decentralizing the choice of DRG tariffs, by allowing regional governments to differentiate their fees from national ones, does not guarantees superior outcomes *per se*, since a process of regulatory capture could be at work if private hospitals are strong enough. A particular attention to providersô behavioural responses has thus to be paid by regional governments, as the weight of private providers with respect to total supply of hospital services can even revert the positive effects stemming from the introduction of region-specific pricing policies.

As for the institutional characteristics of regional governments, confirming previous findings in fiscal federalism literature, our results suggest that having access to significant own revenues for funding health expenditure appears to provide the right incentives to regional governments to control inappropriateness, making them more accountable towards citizens-voters for the use of public resources. This suggests investigating effectiveness and viability of the policy option of asymmetric federalism, that is allowing spending autonomy only to those regional governments characterized by a low degree of VFI. Furthermore, a longer experience of the regional governor can play a positive role in building the necessary management capacity which allows setting (or at least replicating) the best practices in the sector. But this reducing effect on inappropriateness can be mitigated by the political alignment of regional governments with the central government, since politically aligned regions emerge as less able to control inappropriateness the longer the experience of their president. In this perspective, these results can raise some questions on the recent decision to introduce a limit in consecutive terms also for regional governors.

While we did our best in the attempt to separate ñappropriateò caesarean from ñinappropriateò ones, controlling for variables capturing average patientsô characteristics and the riskiness of birth, our exercise could not consider a number of variables affecting differences in medical practice (for instance, in the evaluation of clinical parameters) or clinical conditions arising during labour, which can influence the need of a caesarean section. This represents a limitation of the present study, that requires the use of micro-data to be (at least partially) solved, and indicates avenues for future research.

Table 2 ï Equation (1): estimation results

Dep. variable: *ln of odds ratio of caesarean deliveries*		MODEL SPECIFICATION§					
		A	B	C	D	E	F - Spatial Panel Fixed effects#
[*a*] *control* variables (x)	mother's age	0.100 **	0.119 ***	0.121 ***	0.127 ***	0.129 ***	0.140 ***
		0.041	*0.041*	*0.042*	*0.039*	*0.035*	*0.037*
	birth rate	-0.120 ***	-0.112 ***	-0.109 ***	-0.085 ***	-0.084 ***	-0.102 ***
		0.020	*0.023*	*0.021*	*0.023*	*0.021*	*0.026*
	% primary school educ (females)	0.011	0.008	0.007	0.007	0.011	0.017 **
		0.009	*0.010*	*0.010*	*0.008*	*0.009*	*0.008*
	neonatal mortality (first 6 days)	0.004	0.005	0.005 *	0.004 *	0.004 **	0.003 **
		0.003	*0.003*	*0.003*	*0.002*	*0.002*	*0.002*
[*b*] *supply* indicators (w)	medical staff (% of total NHS employees)		0.010 **	0.010 *	0.008	0.003	0.012 *
			0.005	*0.005*	*0.005*	*0.006*	*0.007*
	beds in private hospitals (ratio)		0.002	0.001	0.001	0.001	0.002
			0.003	*0.002*	*0.002*	*0.002*	*0.002*
[*c*] *pricing policy* indicators (k)	regional tariffs (dummy)			-0.180 ***	-0.246 ***	-0.260 ***	-0.199 ***
				0.063	*0.066*	*0.080*	*0.072*
	introduction of regional tariffs			0.048	0.055 *	0.066 **	0.076 ***
				0.032	*0.031*	*0.031*	*0.027*
	regional tariffs*(bed in private hospitals)			0.014 ***	0.017 ***	0.015 ***	0.013 ***
				0.004	*0.004*	*0.005*	*0.004*
	introduction of tariffs*(beds in private hospitals)			-0.007 ***	-0.006 **	-0.006 **	-0.006 **
				0.002	*0.002*	*0.003*	*0.002*
[*d*] *political economy* indicators (z)	in line with central government				0.005	-0.013	-0.003
					0.014	*0.016*	*0.017*
	share of own funding				-0.466 *	-0.435 *	-0.504 ***
					0.249	*0.211*	*0.189*
	president gender					-0.021	-0.031
						0.042	*0.032*
	president experience					-0.010 **	-0.009 ***
						0.003	*0.003*
	president experience*(in line with central govenrment)					0.008 ***	0.008 ***
						0.002	*0.002*
	president is a doctor					0.075 ***	0.073 ***
						0.018	*0.014*
constant		-2.800 **	-4.027 ***	-4.080 **	-4.195 ***	-4.012 ***	-5.492 ***
		1.195	*1.405*	*1.466*	*1.393*	*1.267*	*1.633*
# of observation		168	168	168	168	168	168
within R2		0.82	0.83	0.84	0.86	0.87	
test for autocorrelation							
Bhargava et al. DW						1.507	
critical value						*1.79*	
Wooldridge test						2.940	
p-value						*0.163*	
ρ (lag spatial correlation)							-1.332 **
Wald test (for ρ=0)							5.893
p-value							*0.017*
Spatial autocorrelation in the error (λ=0)							
Global Moran I							-0.005
p-value							*0.969*
LM test							0.014
p-value							*0.905*
Robust LM test							0.024
p-value							*0.878*

§Panel fixed effect estimation; robust standard errors in italics; all regressions include year dummies and region fixed effects. Significance levels: 1% ***, 5% **, 10% *.

Row standardised weights (distances) matrix.

Table 3 ï Estimated coefficients ï Model F (Table 2)

Dep. variable: *ln of odds ratio of the incidence of caesarean deliveries* (*y=ln(c/(1-c)*)		Estimated coeff - dependent variable ln of odds ratio of caesarean deliveries (β) §	Transformed coefficients (direct effect on the incidence of caesarean deliveries: $(\delta c/\delta y)^*\beta$) §#
[*a*] *control* variables (*x*)	mother's age	0.140 ***	3.076 ***
		0.037	*0.803*
	birth rate	-0.102 ***	-2.246 ***
		0.026	*0.576*
	% primary school educ (females)	0.017 **	0.371 **
		0.008	*0.180*
	neonatal mortality (first 6 days)	0.003 **	0.076 **
		0.002	*0.035*
[*b*] *supply* indicators (*w*)	medical staff (% of total NHS employees)	0.012 *	0.254 *
		0.007	*0.152*
	beds in private hospitals (ratio)	0.002	0.048
		0.002	*0.041*
[*c*] *pricing policy* indicators (*k*)	regional tariffs (dummy)	-0.199 ***	-4.362 ***
		0.072	*1.570*
	introduction of regional tariffs	0.076 ***	1.676 ***
		0.027	*0.602*
	regional tariffs*(bed in private hospitals)	0.013 ***	0.275 ***
		0.004	*0.093*
	introduction of tariffs*(beds in private hospitals)	-0.006 **	-0.130 **
		0.002	*0.050*
[*d*] *political economy* indicators (*z*)	in line with central government	-0.003	-0.073
		0.017	*0.370*
	share of own funding	-0.504 ***	-11.061 ***
		0.189	*4.153*
	president gender	-0.031	-0.677
		0.032	*0.705*
	president experience	-0.009 ***	-0.196 ***
		0.003	*0.067*
	president experience*(in line with central govenrment)	0.008 ***	0.165 ***
		0.002	*0.045*
	president is a doctor	0.073 ***	1.603 ***
		0.014	*0.302*

§Robust standard errors in italics - Significance levels: 1% ***, 5% **, 10% *.

Impacts on the % of caesarean deliveries are given by $(\delta c/\delta y)^*(\delta y/\delta x_r)=(\delta c/\delta y)^*\beta$.

Table 4 ï Marginal effects§ ï Model F (Table 2)

		Dependent variable (*ln of odds ratio of caesarean deliveries*)			% of caesarean deliveries		
		Total effect	Direct effect	Feedback effect	Total effect	Direct effect	Feedback effect
		$\overline{\mu_{ii}}\beta_r$	β_r	$\left(\overline{\mu_{ii}}-1\right)\beta_r$	$(\delta c_i/\delta y_i)\overline{\mu_{ii}}\beta_r$	$(\delta c_i/\delta y_i)\beta_r$	$(\delta c_i/\delta y_i)\left(\overline{\mu_{ii}}-1\right)\beta_r$
[*a*] *control* variables (*x*)	mother's age	0.152	0.140	0.012	3.336	3.076	0.260
	birth rate	-0.111	-0.102	-0.009	-2.436	-2.246	-0.190
	% primary school educ (females)	0.018	0.017	0.001	0.403	0.371	0.031
	neonatal mortality (first 6 days)	0.004	0.003	0.000	0.082	0.076	0.006
[*b*] *supply* indicators (*w*)	medical staff (% of total NHS employees)	0.013	0.012	0.001	0.275	0.254	0.021
	beds in private hospitals (ratio)	0.002	0.002	0.000	0.052	0.048	0.004
[*c*] *pricing policy* indicators (*k*)	regional tariffs (dummy)	-0.216	-0.199	-0.017	-4.730	-4.362	-0.368
	introduction of regional tariffs	0.083	0.076	0.006	1.818	1.676	0.142
	regional tariffs*(bed in private hospitals)	0.014	0.013	0.001	0.298	0.275	0.023
	introduction of tariffs*(beds in private hospitals)	-0.006	-0.006	-0.001	-0.141	-0.130	-0.011
[*d*] *political economy* indicators (*z*)	in line with central government	-0.004	-0.003	-0.000	-0.079	-0.073	-0.006
	share of own funding	-0.547	-0.504	-0.043	-11.996	-11.061	-0.935
	president gender	-0.033	-0.031	-0.003	-0.734	-0.677	-0.057
	president experience	-0.010	-0.009	-0.001	-0.213	-0.196	-0.017
	president experience*(in line with central government)	0.008	0.008	0.001	0.179	0.165	0.014
	president is a doctor	0.079	0.073	0.006	1.739	1.603	0.135

§ Marginal effects reported in this table are computes as averages over the regions as for example: $\overline{\mu_{ii}}\beta_r = \sum_{i=1}^{N}\mu_{ii}\beta_r$.

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Appendix

In order to test (and account) for the possible presence of spatial correlation, we estimate a spatial model (with fixed effects) of the following type:

$$y_t = X_t\beta + \rho P y_t + \xi_t \qquad \xi_t = \lambda P \xi_t + \nu_t \tag{2}$$

where X_t is the NxR matrix of our regressors (control, supply, pricing policy and political economy indicators), P the (NxN) weights matrix and ν_t the error term. N is the number of regions (equal to 21) and $R=J+F+K+H$ the number of regressors. The model allows in principle for the presence of both lag and error spatial correlation.

Equation (2) can be rewritten as (omitting to report the time subscript for convenience):

$$y = \mathrm{M}X\beta + \mathrm{M}\xi \qquad \text{with } \mathrm{M} = [I - \rho P]^{-1} \tag{3}$$

or

$$y_i = \sum_{j=1}^{N} \mu_{ij} \left(\sum_{r=1}^{R} \beta_r x_{jr} \right) + \sum_{j=1}^{N} \mu_{ij} \xi_j \tag{4}$$

where μ_{ij} are the elements of matrix M.

We can therefore obtain the following marginal effects and elasticities for the dependent variable in region i with respect to variable r in region j:

$$\frac{\delta y_i}{\delta x_{jr}} = \mu_{ij}\beta_r \quad \text{and} \quad \varepsilon_{y_i, x_{jr}} = \frac{\delta y_i}{\delta x_{jr}} \frac{x_{jr}}{y_i} = \mu_{ij}\beta_r \frac{x_{jr}}{y_i} \tag{5}$$

Given that the dependent variable is the (log of the) odds ratio of caesarean deliveries (c_i), i.e. $y_i = ln(c_i/(1-c_i))$, we can also get the marginal effects and elasticities for c_i as follows:

$$\frac{\delta c_i}{\delta x_{jr}} = \frac{\delta c_i}{\delta y_i}\frac{\delta y_i}{\delta x_{jr}} = \frac{\delta c_i}{\delta y_i}\mu_{ij}\beta_r \quad \text{and} \quad \varepsilon_{c_i, x_{jr}} = \frac{\delta c_i}{\delta y_i}\frac{\delta y_i}{\delta x_{jr}}\frac{x_{jr}}{y_i} = \frac{\delta c_i}{\delta y_i}\mu_{ij}\beta_r \frac{x_{jr}}{y_i} \tag{6}$$

We provide examples of the resulting marginal effects and elasticities. For *regional tariffs*, tables 5 and 6 present marginal effects respectively in terms of the dependent variable and the incidence of caesarean deliveries; while tables 7 and 8 report elasticities (in terms of the dependent variable and the incidence of caesarean deliveries) for the *share of own funding*.[26]

Given the estimated coefficients we can also obtain total, direct and feedback, marginal effects.[27] We compute them according to the following equations (where the upper-bar indicates averages over regions):

[26] Results related to all the regressors included in the empirical analysis are available upon request.
[27] For a more general discussion of marginal effects in spatial panel model see Elhorst (2012).

$$
\begin{aligned}
&\text{total effect :} && \overline{\left(\frac{\partial y_i}{\delta x_{ir}}\right)} = \overline{\left(\mu_{ii}\beta_r\right)} = \frac{1}{N}\sum_{i=1}^{N}\mu_{ii}\beta_r = \beta_r\overline{\mu_{ii}} \\
&\text{direct effect :} && \beta_r \\
&\text{feedback effect :} && \beta_r(\overline{\mu_{ii}} - 1)
\end{aligned}
\tag{7}
$$

In this paper, the direct effect is captured by estimated coefficients (β_r). The total effect includes also the feedback (or spillover) effect induced by spatial correlations. Feedback effects arise because changes in variable *r* in region *i* affect also the outcomes in other regions, that in turn affect the outcome in region *i* (according to the weighting matrix P used in the estimation). The feedback effect therefore is computed taking into account such retroactions which are measured by $\overline{\mu_{ii}}$, i.e. the average over regions of the μ_{ii} elements of matrix M.

Table 4 in the main text reports the results. The last three columns present the marginal effects on terms of the incidence of caesarean deliveries; they are computed at sample means of the dependent variable.

Table 5 ï Marginal effects on dependent variable* $(\delta y_i / \delta x_{jr})$

Variable *r*: Regional tariff $\beta_r = -0.199$ $\rho = -1.332$

Region i	Region j 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	-0.224	0.052	0.022	0.004	0.004	0.003	0.002	0.026	0.004	0.004	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.003
2	0.059	-0.220	0.020	0.006	0.006	0.004	0.003	0.011	0.004	0.004	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.002	0.003
3	0.021	0.017	-0.214	0.008	0.014	0.006	0.004	0.025	0.010	0.006	0.003	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.002
4	0.003	0.004	0.008	-0.230	0.078	0.014	0.009	0.004	0.005	0.003	0.002	0.003	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
5	0.003	0.004	0.012	0.071	-0.232	0.018	0.007	0.005	0.009	0.004	0.002	0.003	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
6	0.002	0.003	0.006	0.014	0.019	-0.214	0.026	0.004	0.019	0.007	0.005	0.008	0.002	0.003	0.002	0.001	0.002	0.001	0.001	0.001	0.002
7	0.003	0.003	0.004	0.012	0.009	0.033	-0.210	0.004	0.009	0.006	0.006	0.012	0.003	0.004	0.003	0.002	0.003	0.002	0.002	0.002	0.002
8	0.025	0.009	0.026	0.004	0.006	0.005	0.003	-0.213	0.011	0.012	0.005	0.003	0.004	0.002	0.002	0.002	0.001	0.001	0.001	0.002	0.004
9	0.003	0.003	0.008	0.005	0.009	0.018	0.006	0.009	-0.215	0.035	0.009	0.008	0.003	0.003	0.002	0.001	0.001	0.001	0.001	0.001	0.002
10	0.003	0.003	0.005	0.003	0.004	0.007	0.004	0.010	0.036	-0.215	0.021	0.009	0.007	0.005	0.002	0.002	0.002	0.001	0.001	0.002	0.003
11	0.002	0.002	0.002	0.002	0.002	0.005	0.004	0.004	0.009	0.021	-0.214	0.024	0.016	0.019	0.004	0.003	0.002	0.002	0.002	0.002	0.003
12	0.002	0.002	0.003	0.003	0.003	0.008	0.010	0.003	0.009	0.010	0.027	-0.211	0.007	0.017	0.007	0.004	0.004	0.003	0.002	0.002	0.002
13	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.004	0.007	0.018	0.007	-0.214	0.035	0.010	0.011	0.003	0.004	0.003	0.004	0.005
14	0.001	0.001	0.001	0.001	0.001	0.003	0.003	0.002	0.003	0.005	0.019	0.016	0.033	-0.216	0.017	0.009	0.004	0.004	0.002	0.003	0.003
15	0.001	0.001	0.001	0.001	0.001	0.002	0.003	0.001	0.002	0.003	0.005	0.007	0.010	0.018	-0.217	0.038	0.011	0.017	0.004	0.004	0.003
16	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.004	0.004	0.012	0.010	0.040	-0.217	0.007	0.021	0.007	0.008	0.004
17	0.001	0.001	0.001	0.002	0.001	0.002	0.004	0.002	0.002	0.002	0.003	0.005	0.004	0.006	0.015	0.009	-0.214	0.044	0.014	0.005	0.003
18	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.002	0.003	0.003	0.004	0.005	0.020	0.023	0.038	-0.219	0.015	0.006	0.003
19	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.002	0.002	0.003	0.003	0.004	0.005	0.004	0.008	0.012	0.018	0.023	-0.208	0.019	0.006
20	0.002	0.003	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.004	0.004	0.004	0.008	0.005	0.007	0.014	0.007	0.010	0.020	-0.206	0.015
21	0.005	0.005	0.004	0.003	0.003	0.003	0.004	0.007	0.004	0.006	0.006	0.005	0.011	0.006	0.005	0.008	0.005	0.005	0.007	0.016	-0.204

* Dep. variable *y*: ln of odds ratio of caesarean deliveries

Table 6 ï Marginal effects on % caesarean deliveries $(\delta c_i / \delta x_{jr}) = (\delta c_i / \delta y_i)(\delta y_i / \delta x_{jr})$

Variable *r*: Regional tariff

Region i	Region j 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	-4.91	1.14	0.49	0.08	0.09	0.06	0.05	0.57	0.09	0.09	0.05	0.04	0.05	0.03	0.02	0.03	0.02	0.02	0.02	0.03	0.06
2	1.28	-4.83	0.45	0.13	0.12	0.08	0.07	0.24	0.09	0.08	0.05	0.05	0.05	0.04	0.03	0.03	0.03	0.02	0.03	0.04	0.06
3	0.45	0.37	-4.70	0.19	0.31	0.14	0.08	0.56	0.21	0.13	0.06	0.06	0.05	0.04	0.03	0.02	0.03	0.02	0.02	0.03	0.04
4	0.07	0.10	0.18	-5.05	1.70	0.31	0.21	0.08	0.12	0.07	0.05	0.06	0.03	0.03	0.03	0.02	0.03	0.02	0.02	0.02	0.03
5	0.07	0.09	0.26	1.56	-5.10	0.40	0.14	0.11	0.20	0.09	0.05	0.06	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.03
6	0.05	0.06	0.13	0.31	0.43	-4.70	0.58	0.09	0.42	0.16	0.11	0.17	0.05	0.06	0.04	0.03	0.04	0.03	0.03	0.03	0.03
7	0.05	0.07	0.10	0.25	0.19	0.73	-4.60	0.08	0.19	0.13	0.12	0.27	0.07	0.09	0.07	0.05	0.07	0.05	0.05	0.04	0.05
8	0.55	0.20	0.58	0.09	0.13	0.11	0.07	-4.67	0.25	0.25	0.10	0.07	0.08	0.05	0.03	0.04	0.03	0.03	0.03	0.04	0.08
9	0.07	0.06	0.18	0.11	0.20	0.39	0.14	0.21	-4.72	0.78	0.19	0.17	0.07	0.07	0.04	0.03	0.03	0.02	0.02	0.03	0.04
10	0.07	0.06	0.11	0.06	0.09	0.15	0.10	0.21	0.79	-4.71	0.46	0.20	0.14	0.11	0.05	0.05	0.03	0.03	0.03	0.04	0.06
11	0.04	0.04	0.05	0.04	0.05	0.10	0.09	0.08	0.19	0.46	-4.70	0.53	0.36	0.41	0.09	0.07	0.05	0.04	0.03	0.04	0.06
12	0.04	0.04	0.06	0.06	0.07	0.18	0.22	0.07	0.19	0.22	0.58	-4.63	0.16	0.37	0.15	0.08	0.09	0.06	0.05	0.04	0.05
13	0.04	0.04	0.04	0.03	0.03	0.05	0.06	0.07	0.08	0.16	0.40	0.16	-4.69	0.78	0.21	0.24	0.07	0.08	0.06	0.09	0.11
14	0.03	0.03	0.03	0.03	0.03	0.06	0.07	0.05	0.07	0.11	0.42	0.35	0.71	-4.74	0.37	0.19	0.09	0.08	0.05	0.06	0.06
15	0.02	0.02	0.03	0.03	0.02	0.04	0.06	0.03	0.04	0.06	0.10	0.15	0.22	0.40	-4.77	0.83	0.24	0.37	0.09	0.08	0.06
16	0.02	0.02	0.03	0.02	0.02	0.03	0.04	0.04	0.04	0.05	0.09	0.09	0.25	0.23	0.88	-4.76	0.16	0.46	0.15	0.16	0.09
17	0.03	0.03	0.03	0.04	0.03	0.05	0.08	0.04	0.05	0.05	0.07	0.12	0.09	0.13	0.33	0.20	-4.70	0.97	0.30	0.11	0.06
18	0.02	0.02	0.02	0.02	0.02	0.03	0.05	0.03	0.03	0.04	0.06	0.08	0.10	0.11	0.44	0.51	0.84	-4.80	0.33	0.14	0.06
19	0.04	0.04	0.04	0.04	0.03	0.05	0.07	0.05	0.05	0.06	0.07	0.08	0.11	0.10	0.17	0.26	0.40	0.51	-4.57	0.41	0.12
20	0.05	0.06	0.05	0.04	0.04	0.05	0.07	0.07	0.06	0.08	0.09	0.09	0.18	0.12	0.15	0.30	0.16	0.23	0.44	-4.53	0.33
21	0.11	0.11	0.09	0.07	0.06	0.07	0.08	0.15	0.10	0.14	0.14	0.10	0.24	0.13	0.12	0.18	0.10	0.11	0.14	0.36	-4.47

Table 7 ï Elasticity of dependent variable* at sample mean values $\left(\delta y_i / \delta x_{jr}\right)\left(\bar{x} / \bar{y}\right)$

Variable *r*: Share of own funding $\bar{x} = 0.367$ $\bar{y} = -0.730$

Region i \ Region j	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	0.285	-0.066	-0.028	-0.004	-0.005	-0.004	-0.003	-0.033	-0.005	-0.005	-0.003	-0.002	-0.003	-0.002	-0.001	-0.001	-0.001	-0.001	-0.001	-0.002	-0.004
2	-0.075	0.280	-0.026	-0.007	-0.007	-0.005	-0.004	-0.014	-0.005	-0.005	-0.003	-0.003	-0.003	-0.002	-0.002	-0.002	-0.002	-0.001	-0.002	-0.002	-0.004
3	-0.026	-0.021	0.273	-0.011	-0.018	-0.008	-0.005	-0.032	-0.012	-0.008	-0.003	-0.003	-0.003	-0.002	-0.002	-0.001	-0.001	-0.001	-0.001	-0.002	-0.003
4	-0.004	-0.006	-0.010	0.294	-0.099	-0.018	-0.012	-0.005	-0.007	-0.004	-0.003	-0.004	-0.002	-0.002	-0.002	-0.001	-0.002	-0.001	-0.001	-0.001	-0.002
5	-0.004	-0.005	-0.015	-0.091	0.296	-0.023	-0.008	-0.006	-0.012	-0.005	-0.003	-0.004	-0.002	-0.002	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.002
6	-0.003	-0.003	-0.008	-0.018	-0.025	0.273	-0.034	-0.005	-0.024	-0.009	-0.006	-0.010	-0.003	-0.003	-0.002	-0.002	-0.002	-0.001	-0.001	-0.001	-0.002
7	-0.003	-0.004	-0.006	-0.015	-0.011	-0.042	0.267	-0.005	-0.011	-0.007	-0.007	-0.016	-0.004	-0.005	-0.004	-0.003	-0.004	-0.003	-0.003	-0.002	-0.003
8	-0.032	-0.012	-0.033	-0.005	-0.007	-0.006	-0.004	0.271	-0.014	-0.015	-0.006	-0.004	-0.005	-0.003	-0.002	-0.002	-0.002	-0.001	-0.002	-0.002	-0.005
9	-0.004	-0.004	-0.011	-0.006	-0.011	-0.022	-0.008	-0.012	0.274	-0.045	-0.011	-0.010	-0.004	-0.004	-0.002	-0.002	-0.002	-0.001	-0.001	-0.002	-0.002
10	-0.004	-0.003	-0.007	-0.004	-0.005	-0.009	-0.006	-0.012	-0.046	0.274	-0.027	-0.012	-0.008	-0.006	-0.003	-0.003	-0.002	-0.002	-0.002	-0.002	-0.004
11	-0.002	-0.002	-0.003	-0.002	-0.003	-0.006	-0.005	-0.005	-0.011	-0.027	0.273	-0.031	-0.021	-0.024	-0.005	-0.004	-0.003	-0.002	-0.002	-0.002	-0.003
12	-0.002	-0.002	-0.003	-0.004	-0.004	-0.010	-0.013	-0.004	-0.011	-0.013	-0.034	0.269	-0.009	-0.022	-0.008	-0.005	-0.005	-0.004	-0.003	-0.003	-0.003
13	-0.002	-0.002	-0.003	-0.002	-0.002	-0.003	-0.003	-0.004	-0.005	-0.009	-0.023	-0.009	0.272	-0.045	-0.012	-0.014	-0.004	-0.005	-0.004	-0.005	-0.007
14	-0.002	-0.001	-0.002	-0.002	-0.002	-0.003	-0.004	-0.003	-0.004	-0.006	-0.025	-0.020	-0.042	0.275	-0.021	-0.011	-0.005	-0.005	-0.003	-0.003	-0.003
15	-0.001	-0.001	-0.001	-0.002	-0.001	-0.002	-0.003	-0.002	-0.002	-0.003	-0.006	-0.009	-0.013	-0.023	0.277	-0.048	-0.014	-0.022	-0.005	-0.005	-0.003
16	-0.001	-0.001	-0.001	-0.001	-0.001	-0.002	-0.003	-0.002	-0.002	-0.003	-0.005	-0.005	-0.015	-0.013	-0.051	0.276	-0.009	-0.027	-0.009	-0.010	-0.005
17	-0.002	-0.002	-0.002	-0.002	-0.002	-0.003	-0.005	-0.002	-0.003	-0.003	-0.004	-0.007	-0.005	-0.008	-0.019	-0.012	0.273	-0.057	-0.018	-0.006	-0.004
18	-0.001	-0.001	-0.001	-0.001	-0.001	-0.002	-0.003	-0.002	-0.002	-0.002	-0.003	-0.004	-0.006	-0.006	-0.025	-0.030	-0.049	0.279	-0.019	-0.008	-0.004
19	-0.002	-0.002	-0.002	-0.002	-0.002	-0.003	-0.004	-0.003	-0.003	-0.003	-0.004	-0.005	-0.006	-0.006	-0.010	-0.015	-0.023	-0.030	0.265	-0.024	-0.007
20	-0.003	-0.003	-0.003	-0.003	-0.002	-0.003	-0.004	-0.004	-0.003	-0.005	-0.005	-0.005	-0.010	-0.007	-0.009	-0.017	-0.009	-0.013	-0.026	0.263	-0.019
21	-0.007	-0.006	-0.005	-0.004	-0.004	-0.004	-0.005	-0.009	-0.006	-0.008	-0.008	-0.006	-0.014	-0.007	-0.007	-0.010	-0.006	-0.006	-0.008	-0.021	0.260

* Dep. variable *y*: ln of odds ratio of caesarean deliveries

Table 8 ï Elasticity of % caesarean deliveries at sample mean values $\left(\delta c_i / \delta x_{jr}\right)\left(\bar{x} / \bar{c}\right)$

Variable *r*: Share of own funding $\bar{x} = 0.367$ $\bar{c} = 33.15$

Region i \ Region j	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	-0.138	0.032	0.014	0.002	0.002	0.002	0.001	0.016	0.003	0.003	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002
2	0.036	-0.135	0.013	0.004	0.003	0.002	0.002	0.007	0.003	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002
3	0.013	0.010	-0.132	0.005	0.009	0.004	0.002	0.016	0.006	0.004	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
4	0.002	0.003	0.005	-0.142	0.048	0.009	0.006	0.002	0.003	0.002	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
5	0.002	0.002	0.007	0.044	-0.143	0.011	0.004	0.003	0.006	0.002	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.001	0.001
6	0.002	0.002	0.004	0.009	0.012	-0.132	0.016	0.003	0.012	0.004	0.003	0.005	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001
7	0.002	0.002	0.003	0.007	0.005	0.020	-0.129	0.002	0.005	0.004	0.003	0.008	0.002	0.003	0.002	0.001	0.002	0.001	0.001	0.001	0.001
8	0.015	0.006	0.016	0.003	0.004	0.003	0.002	-0.131	0.007	0.007	0.003	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.002
9	0.002	0.002	0.005	0.003	0.006	0.011	0.004	0.006	-0.132	0.022	0.005	0.005	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001
10	0.002	0.002	0.003	0.002	0.002	0.004	0.003	0.006	0.022	-0.132	0.013	0.006	0.004	0.003	0.001	0.001	0.001	0.001	0.001	0.001	0.002
11	0.001	0.001	0.001	0.001	0.001	0.003	0.003	0.002	0.005	0.013	-0.132	0.015	0.010	0.012	0.003	0.002	0.001	0.001	0.001	0.001	0.002
12	0.001	0.001	0.002	0.002	0.002	0.005	0.006	0.002	0.005	0.006	0.016	-0.130	0.004	0.011	0.004	0.002	0.002	0.002	0.001	0.001	0.001
13	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.004	0.011	0.005	-0.132	0.022	0.006	0.007	0.002	0.002	0.002	0.003	0.003
14	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.001	0.002	0.003	0.012	0.010	0.020	-0.133	0.010	0.005	0.002	0.002	0.001	0.002	0.002
15	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.002	0.003	0.004	0.006	0.011	-0.134	0.023	0.007	0.010	0.003	0.002	0.002
16	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.007	0.006	0.025	-0.133	0.005	0.013	0.004	0.005	0.002
17	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.002	0.003	0.003	0.004	0.009	0.006	-0.132	0.027	0.009	0.003	0.002
18	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.003	0.003	0.012	0.014	0.024	-0.135	0.009	0.004	0.002
19	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.002	0.002	0.002	0.003	0.003	0.005	0.007	0.011	0.014	-0.128	0.011	0.003
20	0.001	0.002	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.003	0.002	0.005	0.003	0.004	0.008	0.004	0.006	0.012	-0.127	0.009
21	0.003	0.003	0.003	0.002	0.002	0.002	0.002	0.004	0.003	0.004	0.004	0.003	0.007	0.004	0.003	0.005	0.003	0.003	0.004	0.010	-0.126